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Pond Use by Captive African Penguins (*Spheniscus demersus*) in an Immersive Exhibit Adjacent to Human Bathers

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1 **Pond use by captive African Penguins (*Spheniscus demersus*) in an immersive exhibit**
2 **adjacent to human bathers**

3

4 **Running head**

5 Visitor effect on African Penguins

6

7 **Abstract**

8 Animals in zoos are exposed to a continuous human presence, which affects their behavior and
9 welfare. However, little is known about what role the “visitor effect” has on captive penguins.
10 The African Penguin (*Spheniscus demersus*) is an endangered species commonly housed in zoos
11 worldwide. The aim of this study was to evaluate whether the abundance of human bathers
12 could reduce the average time spent in the water of a colony of African Penguins housed in an
13 exhibit where their pond habitat was adjacent to a swimming pool. Observations were carried
14 out on seven penguins in summer 2009. Data were collected over three time periods
15 (T1=opening of the swimming season, T2=core of the season, T3=late season) of 14 days each.
16 The human disturbance caused by bathers strongly reduced the pond use by penguins at T1 and
17 T2, especially when there were large numbers of visitors. However, at T3, we observed that the
18 overall use of the pond by penguins increased, and the average duration of their diving was no
19 longer dependent on number of visitors.

20 Introduction

21 The animals in zoos and aquaria are subject to a variety of physical, social, dietary, and
22 ecological limitations. In addition, they are exposed to a continuous human presence, which
23 influences their behavior and welfare. Such influence has been defined as the “visitor effect”
24 (Hosey, 2000; Margulis, Hoyos, & Anderson, 2003; Bortolini & Bicca-Marques, 2011). A
25 review by Hosey (2000) led to identification of three different classes in which zoo visitors can
26 influence exhibited animals, namely (1) being a source of stress; (2) being a source of
27 enrichment; (3) being relatively neutral. In a more recent review, Davey (2007) suggested that
28 behavioral responses to visitors are species-specific and related to body size. In particular, while
29 small animals, such as arboreal primates, are usually aware of people, and are likely to respond
30 with a behavior that tends to avoid massive audiences (Chamove, Hosey, & Schaetzel, 1988;
31 Fernandez, Tamborski, Pickens, & Timberlake, 2009), larger animals are generally less
32 responsive (Margulis et al., 2003), or react by displaying aggressive behavior (Anderson,
33 Benne, Bloomsmith, & Maple, 2002; Lukas et al., 2002). The impact of the viewing public on a
34 captive animal is also known to be affected by the habitat provided in the exhibit (Blaney &
35 Wells, 2004). In particular, the visitor effect is more evident in impoverished environments
36 (Broom & Johnson, 1993) whereas it is markedly reduced in naturalistic exhibits that offer
37 shelter for animals to hide from visitors (Mononen, Kasanen, Harri, Sepponen, & Rekila, 2001;
38 Simpson, 2004; Blaney & Wells, 2004).

39

40 One of the biggest challenges of modern zoos is to meet the expectations of visitors, which
41 often include recreation and entertainment, whilst at the same time, providing education on the
42 biology and conservation of endangered species. This goal can be achieved through creating
43 immersive exhibits, which are fascinating to the public and attract visitors, involving them in an
44 interactive environment (Ross & Gillespie, 2009). However, little is known about the influence
45 of these modern facilities on the behavior of exhibited animals.

46

47 Regarding penguins, very few studies have investigated the effect of zoo visitors on these birds
48 (Hosey, 2008). Warren, Parry, Cuthill, & Barham (2003) provided evidence that human
49 presence can affect the behavior of Gentoo (*Pygoscelis papua*) and African (*Spheniscus*
50 *demersus*) Penguins, and they observed, in both species, increased vigilance and activity
51 associated with a persistently high number of people. In this study, the authors also carried out a
52 “disturbance experiment”, consisting of a human stranger walking through the enclosure.
53 During this experimental condition, the birds dramatically increased their walking behavior and,
54 after the person had left the exhibit, vigilance became the dominant activity in the subsequent

few minutes. However, a study by Brooking & Price (2004), that investigated the behavior of the same two species when exposed to visitors, only found a decrease in resting behavior in the African Penguins, without any reduction of the enclosure space utilization, dependent on increasing visitor density. Finally, Condon, Wehnelt, & Turner (2003) showed that, for the Humboldt's Penguin (*Spheniscus humboldti*), the presence of the viewing public both reduced the inactivity of these animals and increased their physical fitness, suggesting a positive response of the birds to the audience.

The African Penguin is an endangered marine bird (BirdLife International, 2012), endemic in South Africa and Namibia. Small groups of *S. demersus* are also exhibited in zoos and aquaria all over the world and, therefore, it is important that welfare specialists understand the impact of the audience on this species. To this end, we investigated the visitor effect on a colony housed in a zoological park in Italy, in order to assess if the presence of visitors results in reduced pool use by penguins.

Methods

The study was carried out on seven adult penguins (two males and five females) of the species *Spheniscus demersus* at the “Bolder Beach” enclosure of the biopark ZOOM Torino (44° 56' N, 7° 25' E), Italy. This exhibit covers an area of 1500 m², including a pond of 120 m² (water depth-maximum 3 m; temperature constantly maintained at 15 °C). The enclosure reproduces the habitat of “Boulders Beach”, a natural nesting site in South Africa. The penguins' pond is physically, but not visually, separated from a swimming pool by two glass panels, which allow complete underwater vision of the animals (Figure 1). The swimming pool receives approximately 35,000 visitors per year, from late May to early September.

Data collection took place in 2009 over three time periods of 14 consecutive days each (T1, T2, T3), described in Table 1. The penguins were naïve to human bathers, and the study was conducted when the novel immersive exhibit had opened to the public for the first time. Moreover, at that time, the penguins had just been transferred from another zoo, which did not have this structural condition. Observations were carried out following the focal animal sampling method (Altmann, 1974) and lasted 14 hours per sampling period (one hour per day). Overall, each penguin was observed for two hours per period. During observation sessions, the number of bathers facing the glass panels (i.e. those that could be viewed by penguins) was constantly monitored and categorized into classes according to abundance: 0 (no visitors), 1 (1 to 15), 2 (16 to 30), 3 (more than 30), and the time spent by penguins in the water was recorded

using a stopwatch Konustart-3 (Konus®). The stopwatch was started when the focal bird spontaneously dived into the pond, and was stopped when the same animal left the water. However, the birds usually entered in and left the pool as a group.

Statistical analyses were carried out using the R software v. 3.0.1 (R Development Core Team 2007, available at <http://cran.r-project.org>) for Macintosh. Since the data did not follow a normal distribution, inferences were made using non-parametric statistical techniques.

Results

Overall, the time spent by penguins in the pond significantly increased at T3 compared to T1 and T2 (Kruskal-Wallis $\chi^2 = 35.47$, $df = 2$, $P < 0.001$; Figure 2). Moreover, at T1 and T2, the average time spent by penguins in the pond was strongly dependent on the abundance classes of the viewing public (T1: Kruskal-Wallis $\chi^2 = 17.28$, $df = 3$, $P < 0.001$; T2: Kruskal-Wallis $\chi^2 = 14.89$, $df = 3$, $P < 0.01$; Figure 3). In particular, the NDWD (Nemenyi Damico Wolfe Dunn) *post-hoc* comparison showed that, in these periods, the birds remained significantly less in the water when there was an abundance of bathers facing the glass panels; comparison between classes 0 and 3 (T1: $P < 0.001$; T2: $P < 0.01$) and between 1 and 3 (T1: $P < 0.001$; T2: $P < 0.01$). Conversely, at T3, the time spent by penguins in the pool was not conditioned by the number of bathers facing the glass panels (T3: Kruskal-Wallis $\chi^2 = 7.44$, $df = 3$, $P > 0.05$; Figure 3).

Discussion

We investigated whether the occurrence and abundance of human bathers have an influence on the pond use, in a colony of African Penguins (*Spheniscus demersus*) housed in an exhibit adjoining a swimming pool. To this end, we monitored the average time spent in the water by seven adult birds over three separate time periods corresponding, respectively, to the seasonal opening of the swimming pool (T1), the core of the season (T2), and the late season (T3).

We observed that the human disturbance due to bathers strongly reduced the pond use by penguins during the T1 and T2 observation periods, especially when large numbers of visitors were present. However, at period T3, we observed that the overall use of the pond by the penguins increased, and the average duration of their diving was no longer dependent on the number of people present. This is in line with the study by van Heezik & Seddon (1990), which showed that wild African Penguins exposed to a regular disturbance exhibit a high level of tolerance to visitors. More recently, Seddon & Ellenberg (2008) also confirmed that tolerance to

human proximity, by penguins, varies according to many different factors, including their own previous experience. Finally, a study by Condon et al. (2003), performed on ten captive Humboldt penguins (*Spheniscus humboldti*) housed at Chester Zoo (United Kingdom), showed that the viewing public has a positive effect on the diving behavior of these birds. Specifically, they observed an increase of submerged swimming relative to the presence of visitors, as a result of human interaction through glass windows. Conversely, in our scenario, we did not observe any positive influence exerted by human bathers in relation to pond use by the African Penguins. In wild Yellow-eyed Penguins (*Megadyptes antipodes*), behavioral responses to human disturbance can vary according to both individuality and gender (Ellenberg, Mattern, & Seddon, 2009). However, these differences were not evident in other species (e.g. Ellenberg, Mattern, Houston, Davis, & Seddon, 2012), and have never been reported for the African Penguin. Further studies, carried out on a larger number of penguins of both sexes would be useful to investigate whether these differences exist in this species.

Immersive exhibits represent a modern and attractive alternative to traditional zoo enclosures (Ross & Gillespie, 2009). However, even if these exhibits provide a unique, interactive environment for the viewing public, thus contributing an added value for education and awareness purposes, the disadvantage is they could affect the behavior of animals due to the close proximity to humans. Beale & Monaghan (2004) suggested that sea birds perceive the human disturbance as a potential predation risk. Since predators of the wild adult African Penguin are mostly aquatic animals such as the great white shark (*Carcharodon carcharias*) (Randall B.M., Randall R.M., & Compagno, 1988; Johnson, Venter, Bester, & Oosthuizen, 2006) and the Cape fur seal (*Arctocephalus pusillus pusillus*) (du Toit, Barlett, Bester, & Roux, 2004; Johnson et al., 2006), we hypothesize that, at periods T1 and T2, the bathers facing the glass panels that separated the pond from the swimming pool were perceived by the members of colony as a potential threat. Consequently, penguins avoided using the pond, particularly when there were large groups of visitors. We also suggest that the increased use of the pond, observed at T3, was a result of a gradual habituation to human visitors that were no longer perceived by the birds as potential predators.

Further research, taking into account a larger number of penguins, and comparing similar scenarios, would be especially valuable, in order to gain a more complete understanding of this behavior. We also recommend that zoos and aquaria, which do not exhibit penguins for extended periods of time throughout the year, pay particular attention to the needs of these birds

at the beginning of the opening season, in order to re-habituate them to a massive audience exposure.

Conclusions

1. The presence of human bathers facing the glass panels reduced the average time spent by the penguins in the pond at T1 (opening of the swimming season) and T2 (core of the season).
2. In these periods of observation, the time spent by the birds in the pond was also strongly dependent on the abundance classes of the viewing public.
3. At time T3 (late season), the penguins habituated to presence of humans, and their use of the pond was no longer influenced by the presence or abundance of the public.

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- 242

Table 1. Brief descriptions of the three periods of observation.

	Days	Description
T1	May 30 th – June 14 th	Opening of the swimming season
T2	June 30 th – July 14 th	Core of the season
T3	July 31 th – August 14 th	Late season



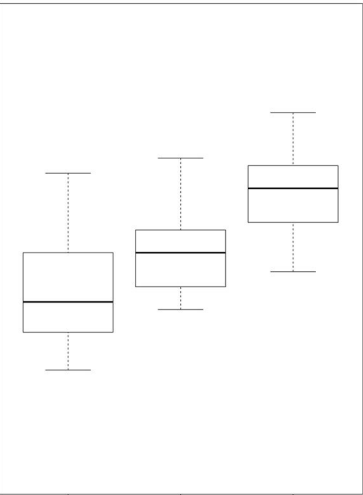
Minutes

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T1

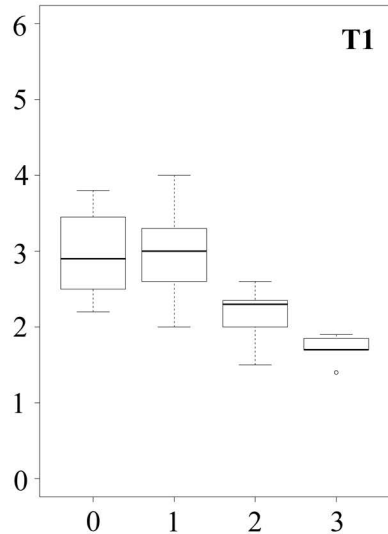
T2

T3

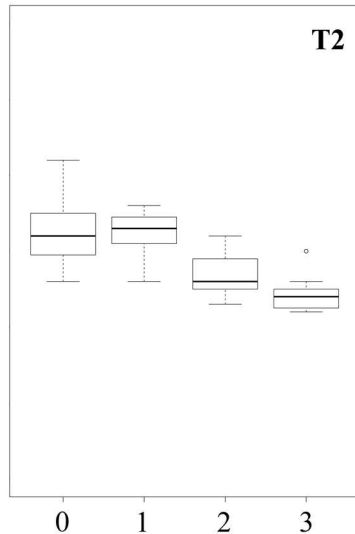


Minutes

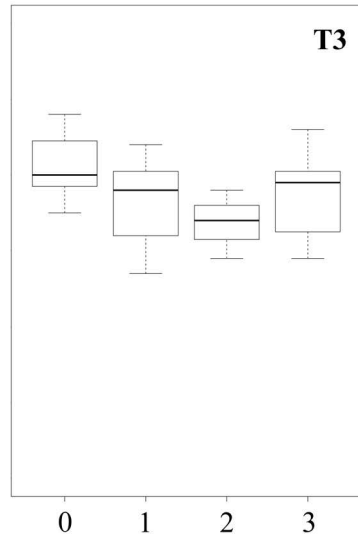
T1



T2



T3



Abundance classes of visitors